## REMARKS

Claims 90 and 93-141 are pending in this application.

Claims 90, 108 and 130 have been amended to clarify that the capacitor of the present invention overlies within lateral boundaries of the field oxide region and over an upper surface of the field oxide region. No new matter has been introduced. Applicants submit that Figures 3 and 13 of the application illustrate capacitors 199, 299 having capacitor electrodes formed completely outside the active region of pixel sensor cell 100, 200 and completely within lateral boundaries of field oxide region 115, and over an upper surface of field oxide region 115.

Claim 124 stands rejected under 35 U.S.C. § 112, first paragraph, as "forming the capacitor over the active area of the photosensor would block light from reaching the photosensitive area." (March 22, 2006 Office Action at 2). In the Amendment dated May 5, 2006, claim 124 has been amended to clarify that the charge storage capacitor "overlies an active area of a pixel containing said photosensor." Applicants submit that, in a pixel containing a photosensor with a capacitor located over an active area of the pixel, light can be still detected by parts of the photosensor that are not covered by the charge storage capacitor. In addition, materials used for capacitor construction are transparent so light passes through the capacitor to the photosensor. For example, as described in the specification (e.g. ¶ 45-47), polysilicon can be used for the capacitor electrodes and silicon oxide can be used for the dielectrics, which are transparent to image light. Other examples of transparent material for the electrodes and dielectrics are described, for example, in paragraphs 45-47. Accordingly, even in those areas where the capacitor overlies the photosensor, the photosensor still senses light passing through the capacitor. Thus, the existence of a capacitor over the active area of the photosensor does not preclude operation of the photosensor. Withdrawal of the rejection of claim 124 is respectfully requested.

Claims 90 and 93-141[1] stand rejected under 35 U.S.C. §102(b) as being anticipated by Rhodes (U.S. Patent No. 6,204,524) ("Rhodes"). This rejection is respectfully traversed.

The claimed invention relates to a method of forming a CMOS imager with improved charge storage. As such, amended independent claim 90 recites a "method of forming a CMOS imager" by *inter alia* "providing a semiconductor substrate having a doped layer of a first conductivity type" and "forming a first doped region of a second conductivity type in said doped layer, said first doped region being adjacent a field oxide region, said field oxide region being defined by lateral boundaries, a lower surface and an upper surface."

Amended independent claim 90 also recites "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region" and "forming a direct contact between said first doped region and said charge storage capacitor."

Amended independent claim 108 recites a "method of forming a CMOS imager" by *inter alia* "providing a semiconductor substrate having a doped layer of a first conductivity type," "forming a field oxide region within said semiconductor substrate, said field oxide region being defined by lateral boundaries, a lower surface and an upper surface" and "forming a first conductive layer over said field oxide region and said substrate." Amended independent claim 108 also recites "forming an insulating layer over said first conductive layer," "forming a second conductive layer over said insulating layer" and "patterning said first conductive layer, said insulating

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[1] Applicants note that claims 91 and 92 have been canceled in the Amendment dated September 29, 2004. Accordingly, only claims 90 and 93-141 (and not 90-141, as the Office Action asserts) could be rejected

layer and said second conductive layer to form a storage capacitor and an electrical element of said CMOS imager, wherein the entire extent of said storage capacitor is formed within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region."

Independent claim 122 recites a "method of forming an imager" by *inter alia* "forming a photosensor including a charge collection region," "forming a floating diffusion region for receiving charge from said charge collection region" and "forming a charge storage capacitor . . . so that one electrode of said storage capacitor is connected directly to said floating diffusion region by an electrical contact."

Amended independent claim 130 recites a "method of forming an imager" by *inter alia* "forming a field oxide region in said semiconductor substrate, said field oxide region being defined by lateral boundaries, a lower surface and an upper surface," "forming a photodiode in said doped layer" and "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region." Amended independent claim 130 also recites "connecting an electrode of a charge storage capacitor directly to said photodiode by an electrical contact."

Independent claim 137 recites a "method of forming an imager" by *inter alia* "forming a photosensor including a charge collection region," "forming a floating diffusion region for receiving charge from said charge collection region" and "connecting an electrode of a first charge storage capacitor to said floating diffusion region by a first electrical contact." Independent claim 137 further recites "connecting an electrode of a second charge storage capacitor to said charge collection region by a second electrical contact."

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under 35 U.S.C. §102(b) as being anticipated by Rhodes (U.S. Patent No. 6,204,524).

Rhodes relates to a CMOS imager that "provides improved charge storage by fabricating a storage capacitor in parallel with the photocollection area of the imager." (Abstract). According to Rhodes, "[t]he storage capacitor may be a flat plate capacitor formed over the pixel, a stacked capacitor or a trench imager formed in the photosensor." (Abstract).

The March 22, 2006 Office Action fails to recognize that Rhodes does not disclose all limitations of the claimed invention. Applicants submit that that courts have repeatedly emphasized that anticipation is established only if (1) all the elements of an invention as stated in a patent claim (2) are identically set forth (3) in a single prior art reference.[2] Thus, the standard for anticipation or lack of novelty is strict identity. See, e.g., Novo Nordisk A/S v. Becton Dickinson & Co., 96 F. Supp. 2d 309, 312 (S.D.N.Y. 2000) ("It is not sufficient that each element be found somewhere in the reference, the elements must be 'arranged as in the claim.' *Lindemann Maschinenfabrik GMBH v. American Hoist and Derrick Co.*, 703 F.2d 1452, 1458 (Fed. Cir. 1984). Further, the reference must be sufficiently clear so as to prove the existence of each and every element in the reference."); Verve, LLC v. Crane Cams, Inc., 311 F.3d 1116, 1120 (Fed. Cir. 2002) ("A single reference must describe the claimed invention with sufficient precision and detail to establish that the subject matter existed in the prior art."); C.R. Bard, Inc. v. M3 Systems, Inc., 157 F.3d 1340, 1349 (Fed. Cir. 1998), *rehearing denied & suggestion for rehearing in banc declined*, 161 F.3d 1380 (Fed. Cir. 1998), *cert denied*, 526 U.S.

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[2] See, e.g., Gechter v. Davidson, 116 F.3d 1454, 1457 (Fed. Cir. 1997) ("Under 35 U.S.C. § 102, every limitation of a claim must identically appear in a single prior art reference for it to anticipate the claim."); Glaverbel Societe Anonyme v. Northlake Marketing & Supply, Inc., 45 F.3d 1550, 1554 (Fed. Cir. 1995) ("Anticipation requires identity of the claimed process and a process of the prior art; the claimed process, including each step thereof, must have been described or embodied, either expressly or inherently, in a single reference."; "Anticipation . . . requires identity of invention: the claimed

1130 (1999) ("When the defense of lack of novelty is based on a printed publication that is asserted to describe the same invention, a finding of anticipation requires that the publication describe all of the elements of the claims, arranged as in the patented device."); Hazani v. U.S. Int'l Trade Comm'n, 126 F.3d 1473, 1477 (Fed. Cir. 1997) ("To anticipate a claim, a prior art reference must disclose every feature of the claimed invention, either explicitly or inherently.").

In the present case, and as the case law requires, Rhodes must disclose every feature of the claimed invention. Rhodes fails to disclose, however, all limitations of claims 90 and 93-141. Rhodes does not disclose, teach or suggest "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region" and "forming a direct contact between said first doped region and said charge storage capacitor," as amended independent claim 90 recites. Rhodes is also silent about "patterning said first conductive layer, said insulating layer and said second conductive layer to form a storage capacitor and an electrical element of said CMOS imager, wherein the entire extent of said storage capacitor is formed within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as amended independent claim 108 recites.

Applicants submit that capacitor 162 of Rhodes simply does not completely lie over field oxide region 115 so that capacitor 162 is located within lateral boundaries of the field oxide region 115 and over an upper surface of the field oxide region 115. As described and illustrated in all figures of Rhodes, the trench and planar capacitor structures of Rhodes are all formed overlying the active area of the pixel sensor cell, and not "within said lateral boundaries of said field oxide region and above said upper

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invention, as described in appropriately construed claims, must be the same as that of

surface of said field oxide region," as claims 90, 108 and 130 recite. Applicants also note that the Abstract of Rhodes clearly specifies that "[t]he storage capacitor may be a flat plate capacitor *formed over the pixel,* a stacked capacitor or a trench imager formed in the photosensor" (emphasis added), and not a capacitor overlying "within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region," as in the claimed invention. Applicants further note that Figure 5 of Rhodes clearly shows parts of electrodes 156 and 160 of the capacitor 162 formed over the doped region 155 and the photogate 102 of the transistor 125 of Rhodes. Thus, storage capacitor 162 of Rhodes is not illustrated in Figure 5 as overlying "within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region," as in the claimed invention.

Rhodes also does not disclose, teach or suggest "forming a floating diffusion region for receiving charge from said charge collection region" and "forming a charge storage capacitor . . . so that one electrode of said storage capacitor is connected directly to said floating diffusion region by an electrical contact," as independent claim 122 recites. In Rhodes, storage capacitor 162, which would arguably correspond to the "charge storage capacitor" of the claimed invention, is connected to a fifth doped region 155 ("which is formed adjacent to the photogate 102") and not to the floating diffusion region 130. In addition, no electrode of the storage capacitor 162 of Rhodes is connected directly to a floating diffusion region "by an electrical contact," as in the claimed invention.

Rhodes is also silent about "forming a photodiode in [a] doped layer," "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and over said

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the reference, in order to anticipate.").

upper surface of said field oxide region" and "connecting an electrode of a charge storage capacitor directly to said photodiode by an electrical contact," as amended independent claim 130 recites. As described and illustrated in all figures of Rhodes, the trench and planar capacitor structures of Rhodes are all formed overlying the active area of the pixel sensor cell, and not "within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as recited in claim 130. Applicants also note that Figure 5 of Rhodes clearly shows parts of electrodes 156 and 160 of the capacitor 162 formed over the doped region 155 and the photogate 102 of the transistor 125 of Rhodes. Thus, storage capacitor 162 of Rhodes is not illustrated in Figure 5 as overlying "within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as in the claimed invention.

Rhodes is also silent about "connecting an electrode of a first charge storage capacitor to [a] floating diffusion region by a first electrical contact," much less "connecting an electrode of a second charge storage capacitor to said charge collection region by a second electrical contact," as independent claim 137 recites. As noted above, Rhodes does not disclose, teach or suggest the step of connecting an electrode of a storage capacitor to a "floating diffusion region by a first electrical contact," as in the claimed invention. Rhodes is also silent about a "first charge storage capacitor" and a "second charge storage capacitor," much less about "connecting an electrode of a second charge storage capacitor to [a] charge collection region by a second electrical contact," as independent claim 137 recites.

For at least these reasons, Rhodes fails to anticipate the subject matter of claims 90 and 93-141, and withdrawal of the rejection of these claims is respectfully requested.

Claims 130-136 stand rejected under 35 U.S.C. §102(b) as being anticipated by Han et al. (U.S. Patent Pub. No. 2001/006238) ("Han"). This rejection is respectfully traversed.

Han relates to an image sensor that "includes a plurality of unit pixels for sensing a light beam to generate an image data." (Abstract). Han teaches that each of the unit pixels further includes "a photoelectric element for sensing a light beam incident thereto and generating photoelectric charges, a transistor including a gate dielectric formed adjacent to the photoelectric element and a gate electrode formed on top of the gate dielectric and a capacitor structure." (Abstract). According to Han, the capacitor includes "an insulating film formed on a portion of the photoelectric element and a bottom electrode, wherein the insulating film and the gate dielectric are made of a same material and the bottom electrode and the gate electrode are made of a same material." (Abstract).

As noted above, amended independent claim 130 recites a "method of forming an imager" by *inter alia* "forming a field oxide region" and "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region." Amended independent claim 130 also recites "connecting an electrode of a charge storage capacitor directly to said photodiode by an electrical contact."

Han fails to anticipate the subject matter of claims 130-136. Han does not disclose, teach or suggest all limitations of independent claim 130. Han fails to disclose, teach or suggest "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies said field oxide region," as claim 130 recites. In Han, capacitor 230 is formed over both the active area and the isolation region 208, and not

"such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as in the claimed invention. For at least these reasons, Han fails to anticipate the subject matter of claims 130-136 and withdrawal of the rejection of these claims is respectfully requested.

Claims 95-103, 108-121 and 130-136 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Rhodes in view of Han. This rejection is respectfully traversed.

The subject matter of claims 95-103, 108-121 and 130-136 would not have been obvious over Rhodes in view of Han. Specifically, the Office Action fails to establish a *prima facie* case of obviousness. Courts have generally recognized that a showing of a *prima facie* case of obviousness necessitates three requirements: (i) some suggestion or motivation, either in the references themselves or in the knowledge of a person of ordinary skill in the art, to modify the reference or combine the reference teachings; (ii) a reasonable expectation of success; and (iii) the prior art references must teach or suggest all claim limitations. <u>See e.g.</u>, <u>In re Dembiczak</u>, 175 F.3d 994, 50 (Fed. Cir. 1999); <u>In re Rouffet</u>, 149 F.3d 1350, 1355 (Fed. Cir. 1998); <u>Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc.</u>, 75 F.3d 1568, 1573 (Fed. Cir. 1996).

In the present case, Rhodes and Han, whether alone or in combination, fail to disclose, teach or suggest all limitations of independent claims 90, 108 and 130. Rhodes does not disclose, teach or suggest "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region," as amended independent claim 90 recites. Rhodes is also silent about "patterning said first conductive layer, said insulating layer and said second conductive layer to form a

storage capacitor and an electrical element of said CMOS imager, wherein the entire extent of said storage capacitor is formed within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as amended independent claim 108 recites.

Applicants resubmit that, as described and illustrated in all figures of Rhodes, the trench and planar capacitor structures of Rhodes are all formed overlying the active area of the pixel sensor cell, and not "within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region," as claims 90, 108 and 130 recite. Applicants also note that the Abstract of Rhodes clearly specifies that "[t]he storage capacitor may be a flat plate capacitor *formed over the pixel*, a stacked capacitor or a trench imager formed in the photosensor" (emphasis added), and not a capacitor overlying "within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region," as in the claimed invention. Applicants also note that Figure 5 of Rhodes clearly shows parts of electrodes 156 and 160 of the capacitor 162 formed over the doped region 155 and the photogate 102 of the transistor 125 of Rhodes. Thus, storage capacitor 162 of Rhodes is not illustrated in Figure 5 as overlying "within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region," as in the claimed invention.

Similarly, Han is silent about a "method of forming a CMOS imager" by "providing a semiconductor substrate having a doped layer of a first conductivity type," "forming a first doped region of a second conductivity type in said doped layer, said first doped region being adjacent a field oxide region" and "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and above said upper surface of said field oxide region," as amended independent claim 90 recites. Han also fails to teach or suggest a "method of forming a CMOS imager" by "patterning said first

conductive layer, said insulating layer and said second conductive layer to form a storage capacitor and an electrical element of said CMOS imager, wherein the entire extent of said storage capacitor is formed within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as amended independent claim 108 recites. In Han, capacitor 230 is formed over both the active area and the isolation region 208, and not "within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as in the claimed invention.

Rhodes and Han, alone or in combination, also fail to disclose all limitations of amended independent claim 130. Neither Rhodes nor Han discloses, teaches or suggests "forming a charge storage capacitor such that the entire extent of said charge storage capacitor overlies within said lateral boundaries of said field oxide region and over said upper surface of said field oxide region," as amended independent claim 130 recites.

Applicants also submit that a person of ordinary skill in the art would not have been motivated to combine Rhodes with Han to arrive at the claimed invention. On one hand, the crux of Rhodes is the formation of a CMOS imager which comprises a storage capacitor formed in parallel with a photocollection area of the imager, to improve the signal-to-noise ratio and the dynamic range. Rhodes clearly emphasizes that "the storage capacitor [is] formed in parallel with a light sensitive node of the CMOS imager." (Col. 1, lines 7-10). On the other hand, the crux of Han is a method of manufacturing a capacitor so that the insulating film of the capacitor and the gate dielectric of an adjacent transistor are made of a same material, while the bottom electrode of the capacitor and the gate electrode are also made of a same material Accordingly, a person of ordinary skill in the art would not have been motivated to combine Rhodes, which teaches formation of a capacitor in parallel with a sensitive

node of the CMOS imager and independent of the formation of adjacent transistor structures, with Han, which teaches methods of forming a capacitor concurrently with the formation of the adjacent transistor structures, so that elements of the capacitor are formed of same material as that of the transistor elements.

For at least these reasons, Applicants submit that the Office Action fails to establish a *prima facie* case of obviousness, and withdrawal of the rejection of claims 95-103, 108-121 and 130-136 is respectfully requested.

Claims 137-141 stand rejected under 35 U.S.C. §103 as being unpatentable over Rhodes in view of Lauxtermann et al. (U.S. Patent Pub. No. 2001/0015831) ("Lauxtermann"). This rejection is respectfully traversed.

As noted above, independent claim 137 recites a "method of forming an imager" by *inter alia* "forming a photosensor including a charge collection region," "forming a floating diffusion region for receiving charge from said charge collection region" and "connecting an electrode of a first charge storage capacitor to said floating diffusion region by a first electrical contact." Independent claim 137 further recites "connecting an electrode of a second charge storage capacitor to said charge collection region by a second electrical contact."

Lauxtermann relates to "a method for operating a CMOS image sensor including a matrix of pixels (50) arranged in a plurality of lines and columns, each of said pixels including a photosensor element (PD) accumulating charge carriers in proportion to the illumination thereof and storage means (C1,55) able to be coupled to said photosensor element (PD) at a determined instant in order to generate a sampled signal representative of said charge carriers accumulated by the photosensor, the storage means (C1, 55) being intended to assure storage for the purpose of reading said

sampling signal." (Abstract). According to Lauxtermann, "when said sampled signal, stored across said storage means is read, the photosensor element is held at a voltage such that any charge carrier generated by the latter is drained and thus does not disturb the sampled signal stored on the storage means." (Abstract).

The subject matter of claims 137-141 would not have been obvious over Rhodes in view of Lauxtermann. As noted above, Rhodes fails to disclose, teach or suggest all limitations of independent claim 137. Rhodes is silent about "connecting an electrode of a first charge storage capacitor to [a] floating diffusion region by a first electrical contact," much less "connecting an electrode of a second charge storage capacitor to said charge collection region by a second electrical contact," as independent claim 137 recites. Rhodes also does not disclose, teach or suggest the step of connecting an electrode of a storage capacitor to a "floating diffusion region by a first electrical contact," as in the claimed invention. Rhodes is also silent about a "first charge storage capacitor" and a "second charge storage capacitor," much less about "connecting an electrode of a second charge storage capacitor to [a] charge collection region by a second electrical contact," as independent claim 137 recites.

Similarly, Lauxtermann is silent about any of the limitations of claim 137. Lauxtermann relates to a method of maintaining constant the sampled charge stored in memory node 55 during the read process (¶[0010]), and not to methods of forming CMOS imagers, much less to methods of forming CMOS imagers by the specific steps of the claimed invention. Accordingly, and for at least these reasons, the Office Action fails to establish a *prima facie* case of obviousness. Withdrawal of the rejection of claims 137-141 is also respectfully requested.

Allowance of claims 90 and 93-141 is solicited.

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